Assessment of Phytodiversity and Productivity of Steppic Grasslands from ROSCI0201 Podișul Nord-Dobrogean

Evaluarea fitodiversității și productivității pajiștilor stepice din ROSCI0201 Podișul Nord-Dobrogean

Teodor MARUȘCA, Adrian OPREA, Daniyar MEMEDEMIN, Oliviu Grigore POP, Marcel ȚÎBÎRNAC, Daniel Ioan MAFTEI, Ioana SIMION, Elena TAULESCU

Abstract

The natural habitat of community interest 62C0 Ponto-Sarmatic steppes allows the preservation in ROSCI0201 Podișul Nord-Dobrogean protected area of several rare species in danger of becoming extinct due to anthropogenic pressures in particular. In order to recommend effective management measures for biodiversity conservation, it was necessary to investigate the past and current level of degradation of the herbaceous layer of these steppe grasslands and the main factors of anthropogenic impact. Prior to conducting field research activity in 2019, two reference works were studied regarding the phytocoenosis of the steppe grasslands from Babadag Plateau (1970) and Casimcei Plateau (1975) as an integral part of the Podișul Nord-Dobrogean protected area, the information being used to evaluate the productivity of the grasslands for that period. Generally speaking, the productivity of plant associations from Festucion rupicolae alliance is higher than that of plant associations from Pimpinello-Thymion zygioidi alliance and the grasslands of Babadag, closer to the Black Sea and the Danube Delta, are more valuable than those from Casimcei Plateau, located west of the sea shore in a drier climate. From the synthesis of the 152 surveys of 62C0* Ponto-Sarmatic steppes habitat, carried out in 2019, a list of 350 plant species was compiled, of which 44 species belong to Poaceae Family, 23 species belong to Fabaceae and 283 species to other families. Of these plants, 24 species are rare with protection status, eight are native expansive species and nine are alien plant species with different characteristics regarding their invasive potential. The pastoral value of the herbaceous layer is considered poor (23.5), the grass production is 2.72 t/ ha useful plant biomass which allows a rather low optimal stocking rate, of only 0.23 Livestock Unit (LU)/ ha for a 185-day grazing season. Compared to the average productivity of the grasslands of Babadag and Casimcea from 45-50 years ago, the pastoral value decreased by 0.15% per year, the production of useful grass and the stocking rate (optimal loading of livestock) by 0.5% per year, mainly due to the permanent overgrazing. The current stocking rate for pastures from the 20 localities of the studied area is 1.06 LU/ ha, exceeding 4.6 times the optimal load evaluated on the basis of floristic plot and 3.1 times the projected load recommended by the plans developed for grazing. For these reasons, in order to preserve biodiversity and landscapes, we propose to regulate grazing in*

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terms of optimum stocking rate and grazing duration, as well as to expand the cultivation of forage plants in arable land.

Keywords*: steppe grasslands, phytodiversity, pastoral value, forage production, stocking rate*

Introduction

One of the first objectives taken into consideration when establishing a protected area is the conservation of biodiversity. The main factor influencing permanent grasslands is man and his livestock, respectively the anthropo-zoogenic factor.

Overgrazing or under stocking until abandonment of grazing are the main causes of degradation of grassland biodiversity in the temperate area. Establishing the right stocking rate is very important in order to maintain an optimal balance between grass production and the number of livestock per hectare in the grazing season (REDFEARN, BIDWELL, 2003).

To begin with, it is necessary to know the productivity (production and forage quality) of the herbaceous layer from the studied permanent grassland. The method of determining by mowing in protected premises and establishing the degree of grass consumption is the most accurate, but also the most difficult to implement, sometimes impossible. For this reason, a new method of evaluating the productivity of the grasslands based on floristic surveys has been used (MARUȘCA, 2019; MARUȘCA *et alii*, 2019).

By this simpler and easy to apply method, sufficiently accurate results can be obtained in order to assess the productivity of grassland, namely the pastoral value, the useful grass production on the basis of which the stocking rate expressed in livestock unit (LU) per hectare is calculated. This method can be applied for both older and more recent vegetation studies, in order to analyse the dynamics of the economic and productive potential.

Materials and Methods

In order to evaluate the productivity of the grasslands, two synthesis papers on the vegetation of the Babadag Plateau (DIHORU, DONIȚĂ, 1970) and Casimcei Plateau (HOREANU, 1974) as component parts of the Podișul Nord-Dobrogean (PND) were studied. The data was needed to evaluate the productivity dynamics for the last 45-50 years.

Between May-September 2019, the team that studied in the field the non-forest habitats in the PND, more specifically the natural habitat of community interest 62C0* Ponto-Sarmatic steppes, targeting the steppe grasslands, drew up 152 floristic surveys. The studies were carried out within the project "Integrated management of the Podișul Nord-Dobrogean (MIPoNoDo), SMIS code 116964". In order to investigate in more detail the current level of

degradation of the herbaceous layer, special attention was paid to the hollows on the ground due to the overgrazing and to the fixed or movable stones from the surface of the ground.

The appreciation of the participation (P) of the plant species in the grass layer was made directly in percentages according to the KLAPP-ELLENBERG method (MARUȘCA, 2019), in order to facilitate synthesis and subsequent calculations. Likewise, in order to evaluate the productivity of the grasslands, the species were organized into large economic groups: grasses, legumes and other families.

For each species the presence (K) was indicated as number and percentage of total surveys, participation (P) in percentages, forage value index (F) after KOVACS (1979), PĂCURAR, ROTAR (2014) and MARUȘCA (2016) and finally the useful green mass index (M) after MARUȘCA (2019).

After the floristic list has been drawn up with the component species of the herbaceous layer and their participation in the useful green mass, the next step is the application of some formulas for determining the pastoral value (PV), namely:

$$Pv = \Sigma P (\%) \times F/9$$

Where:
Pv = pastoral value indicator (0-100)
P = participation of species in the herbaceous layer (%)
F = foraging value index

Having available the synthetic tables with the participation (%) of the species it was possible to calculate the pastoral value based on the forage quality indices (F).

For the floristic survey using the percentage participation of the species, for each species we noted the forage quality index (F), which can have values ranging from 0 to 9, 0 for all plants without forage value or with indices 1 (toxic plants), 2 (plants that depreciate the quality of the products) and 3 (harmful to herbaceous layer), followed by the rest of the indices from 4 to 9, meaning the forage value:

Foraging value indices (F)
1 = toxic for livestock or humans;
2 = plants that depreciate the quality of the products;
3 = harmful to herbaceous layer;
4 = poor in forage value (ballast species);

5 = mediocre in forage value (former F1);
6 = average in forage value (former F2);
7 = good in forage value (former F3);
8 = very good in forage value (former F4);
9 = excellent in forage value (former F).

After determining the pastoral value indicator, by dividing by 9 the score obtained after multiplying P x F, the quality of grassland is evaluated as follows:

- 0-5 – degraded grassland
- 5-15 – very poor
- 15-25 – poor
- 25-40 – mediocre
- 40-60 – average
- 60-80 – good
- 80-100 – very good.

As in the field there are some difficulties regarding the fencing and guarding of the test surfaces, a new method of indirect determination of the grass production is proposed. The method is based on the floristic surveys and production indices of the green mass for forage species (M) components of the herbaceous layer (Table 1).

The equation for determining the average index for forage green mass production (IM) of permanent grassland phytocoenosis:

$$IM = \frac{4xP(\%)ind.4 + 5xP(\%)ind.5 \ldots\ldots + 9\ x\ P(\%)ind.9}{100}$$

Where: 4 … 9 = indices (marks) of appreciation for forage species
P(%) = species participation in the herbaceous layer
ind. = individual (plant species)

Table 1. Production indices for forage species and estimation of useful production per hectare of unfertilized permanent grassland (MARUȘCA, 2019)
Tabel 1. Indici de producție pentru speciile de furaje și estimarea producției utile pe hectar a pajiștilor permanente nefertilizate (MARUȘCA, 2019)

Average indices of green mass production for forage species (M)	**Transformation coefficients into green mass production (GM)**	**Green mass production estimate (GM) (t/ ha)**	**Production value appreciation**
0,1-0,5 0,5-1,0	x 1,8 x 1,9	0,2-0,9 1,0-1,9	Very poor
1,0-1,5 1,5-2,0	x 2,0 x 2,1	2,0-3,0 3,2-4,2	Poor
2,0-2,5 2,5-3,0	x 2,2 x 2,3	4,4-5,5 5,8-6,9	Poor-Average
3,0-3,5 3,5-4,0	x 2,4 x 2,5	7,2-8,4 8,8-10,0	Average
4,0-4,5 4,5-5,0	x 2,6 x 2,7	10,4-11,7 12,2-13,5	Average-Good
5,0-5,5 5,5-6,0	x 2,8 x 2,9	14,0-15,4 16,0-17,4	Good
6,0-6,5 6,5-7,0	x 3,0 x 3,1	18,0-19,5 20,2-21,7	Good-V. good
7,0-7,5 7,5-8,0	x 3,2 x 3,3	22,4-24,0 24,8-26,4	Very good
8,0-8,5 8,5-9,0	x 3,4 x 3,5	27,2-28,9 29,8-31,5	Excellent

After calculating the IM for the plant association by multiplying with the coefficients given in Table 5, we can estimate the production of green mass usable by animals, in tonnes per hectare.

By this simple method of appreciating the production of green mass (grass) that can be used by animals based on the phytocoenosis floristic plot, an essential contribution is made to establishing the optimal grazing capacity for permanent grassland.

This model has been further improved by introducing transformation coefficients (1.8 to 3.5) which multiplied by production indices (M) gives us the useful grass production (GM t/ ha) (MARUȘCA, 2019).

The required green mass for livestock unit (LU) during the vegetation period is about 12 tonnes, which results from multiplying the feed for 65 kg/ LU with the optimal 185-day grazing season.

The optimum stocking rate (in hectares) is calculated by dividing the production per hectare of a permanent grassland (GM t/ ha) to the required 12 t/ LU/ season.

For the evaluation of the stocking rate of grassland during the grazing season, a new scale of assessment is proposed:

Value	Grassland evaluation
0,01-0,20	Degr. = degraded
0,21-0,40	Vp = very poor
0,41-0,60	P = poor
0,61-0,80	Med. = mediocre
0,80-1,20	Av. = average
1,20-1,60	G = good
1,61-2,00	Vg = very good
Over 2,00	Exc. = excellent

For the final evaluation we also used statistical data offered by the Directorate for Agriculture of Tulcea County. The data regarding the livestock and grassland areas was used to calculate the current stocking rate for the 20 localities included in the Podișul Nord-Dobrogean protected area.

The determination of plant species and habitat types and the evaluation of the initial productivity of the studied grasslands was done according to *** 1952-1976; PUȘCARU-SOROCEANU *et alii*, 1963; ANGHEL *et alii,* 1971; HOREANU, 1974, 1975; ȚUCRA *et alii*, 1987; CRISTEA *et alii,* 2004; SÂRBU *et alii*, 2004; DONIȚĂ *et alii,* 2005; CIOCÂRLAN, 2009; SAMFIRA *et alii*, 2011; SÂRBU *et alii*, 2013.

Results and Discussions

Before beginning the field observations, in 2019, on the vegetation of the steppe grasslands of the Podișul Nord-Dobrogean, were assesed the productivity of the associations belonging to the *Festucion rupicolae* and *Pimpinello-Thymion zygioidi alliances* from the Babadag Plateau and Casimcea Plateau. The evaluation was based on the data gathered from the literature.

Thus, the evaluation of the productivity of the steppe grasslands in the Babadag Plateau highlighted a pastoral value of 32 (mediocre), a forage production of 4.47 t/ ha (poor) and a stocking rate of 0.37 LU/ ha (very poor). (Table 2).

Table 2. Productivity evaluation of steppe grasslands in the Babadag Plateau (after DIHORU & DONIȚĂ, 1970)
Tabel 2. Evaluarea productivității pajiștilor stepice din Podișul Babadag (după DIHORU, DONIȚĂ, 1970)

Phytocoenosis	Pastoral value (PV)	Forage production (GM t/ ha)	Optimal loading (LU/ ha)
Al. *Festucion rupicolae*	**33,0**	**4,97**	**0,41**
As.*Stipo (ucrainicae)-Festucetum valesiacae*	33	4,42	0,37
As. *Crysopogonetum grylli dobrogicum*	15	2,08	0,17
As*. Medicagini-Festucetum valesiacae*	55	8,80	0,75
As. *Cynodonti-Poëtum angustifoliae*	45	12,91	1,08
As. *Elytrigetum intermediae*	45	9,35	0,78
As. *Trigonello (gladiatae)-Orlayetum*	14	1,20	0,10
As. *Bombicilaeno-Botriochloetum ischaemi*	8	0,68	0,06
As. *Poëtum bulbosae*	42	1,62	0,14
As. *Artemisietum austriacae*	25	1,77	0,15
As. *Agropyretum pectiniformae*	48	6,88	0,57
Al. *Pimpinello-Thymion*	**28,3**	**2,78**	**0,23**
As. *Agropyro-Thymetum zygoidi*	29	2,76	0,23
As. *Koelerio-Artemisietum lerchianae*	28	1,14	0,10
As. *Festucetum callierii*	28	4,44	0,37
Average value for phytocoenosis	**31,9**	**4,47**	**0,37**

There are very big differences between plant associations in terms of productivity, as suggested by the indicators used. *Cynodonti-Poëtum angustifoliae* association and *Elytrigetum intermediae* association are considered the most valuable while *Bombicilaeno-Botriochloetum ischaemi* association, *Trigonello (gladiatae)-Orlayetum* association and *Koelerio-Artemisietum lerchianae* association have the lowest value.

Generally speaking, *Festucion rupicolae* alliance is more valuable than *Pimpinello-Thymion zygioidi* alliance in terms of productivity.

In the Casimcei Plateau, grassland productivity is lower than in the Babadag Plateau, due to the distance from the sea who generates climatic conditions with lower humidity (Table 3).

Table 3. Productivity evaluation of the steppe grasslands in the Casimcea Plateau (after HOREANU, 1974)

Tabel 3. Evaluarea productivității pajiștilor stepice din Podișul Casimcei (după HOREANU, 1974)

Phytocoenosis	Pastoral value (PV)	Forage production (GM t/ha)	Optimal loading (LU/ha)
Al. *Festucion rupicolae*	**20,8**	**3,00**	**0,25**
As. *Festucetum valesiacae dobrogicum*	27	2,96	0,25
As. *Stipetum capillatae dobrogicum*	15	1,50	0,13
As. *Chrysopogonetum gryllii dobrogicum*	29	9,80	0,82
As. *Chrysanthemetum millefoliati*	11	1,06	0,09
As. *Agropyretum pectiniformae*	48	4,34	0,36
As. *Botriochloetum ischaemi dobrogicum*	15	1,35	0,11
As. *Artemisio (austriacae) Poëtum (bulbosae) dobrogicum*	16	0,88	0,07
As. *Elytrigetum intermediae*	37	11,52	0,96
As. *Xero-Calamgrostetum epigei*	7	1,04	0,09
As. *Ceratocarpetum arenarii*	5	0,36	0,03
As. *Elymetum asperi*	18	1,54	0,13
Al. *Pimpinello-Thymion zygioidi*	**13,3**	**1,00**	**0,08**
As. *Koelerio (degeni)-Thymetum (zygioidis)*	18	1,39	0,12
As. *Sclerantho-Festucetum callieri*	20	1,46	0,12
As. *Sedo (hillebrandtii)-Polytrichetum (piliferi)*	2	0,14	0,01
Average value for phytocoenosis	**19,2**	**2,62**	**0,22**

The most valuable associations in terms of productivity are *Elytrigetum intermediae* and *Chrysopogonetum gryllii dobrogicum* and the lowest are those from Al. *Pimpinello-Thymion zygioidi* located on rocky grounds.

On average, the associations from Al. *Festucion rupicolae* have a pastoral value of 21, a useful forage production of 3 t/ ha, which allows an optimum loading of 0.25 UVM/ ha, for 185 days grazing period.

152 floristic surveys were made in several trips on the field, between May and September 2019 in the Podișul Nord-Dobrogean area (Figure 1). The

results of field observations on the steppe grassland vegetation are presented in Table 4.

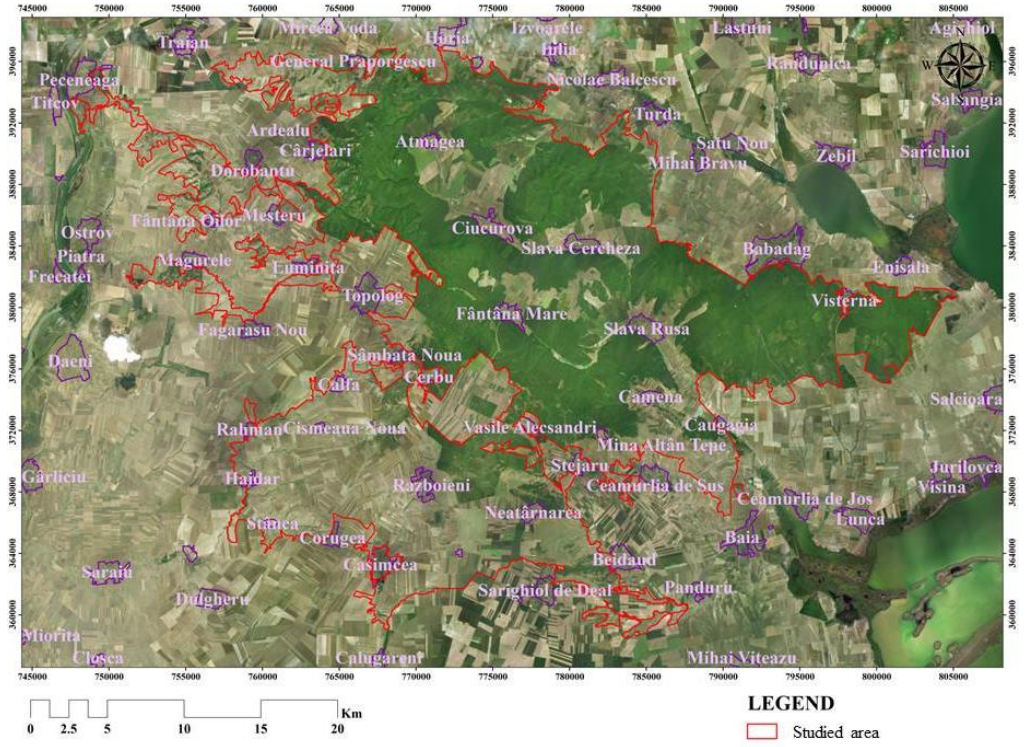

Figure 1. Studied area in ROSCI0201 Podișul Nord-Dobrogean
Fig. 1. Zona studiată în ROSCI0201 Podișul Nord-Dobrogean

From the very beginning there can be noticed a very low average degree of coverage-participation of grassy vegetation, of only 81%, with soil hollows of 14.1% and mobile stones or rocks on 4.9% of the surface.

Following the 152 surveys performed, there were found 350 species, 57 subspecies, 202 genera and 57 families: (AMA = 2 species, ANA 1, API 14, ARI 1, ASC 3, AST 64, BET 1, BOR 8, BRA 14, CAE 1, CAM 2, CAP 2, CAR 16, CHE 4, CON 3, COR 1, CRA 3, CYP 2, DIP 4, ELA 1, EUP 7, FAB 23, FAG 1, GEN 1, GER 2, HYP 2, IRI 2, JUN 1, LAM 27, LIL 4, LIN 1, MAL 3, MOR 2, OLE 2, ORC 1, PAE 1, PLA 2, POA 44, POL 3, POR 1, PRI 1, RAN 7, RES 1, RHA 1, ROS 21, RUB 9, RUT 1, SCR 12, SM 1, SOL 1, TIL 1, ULM 1, URT 1, VAL 1, VER 1, VIO 3, ZYG 2 species), demonstrating exceptional phytodiversity on a fairly small surface.

Table 4. Synthesis of floristic surveys for 62C0* Ponto-Sarmatic steppes natural habitat from ROSCI0201 Podișul Nord-Dobrogean, average productivity and optimal stocking rate for May-September 2019

Tabel 4. Sinteza releveelor floristice pentru habitatul 62C0 Stepe Ponto-Sarmatice din ROSCI0201 Podișul Nord-Dobrogean, productivitatea medie și încărcarea optimă cu animale la pășunat pentru perioada mai-septembrie 2019*

SPECIES	Presence (K) in 152 plots		Average participation (P) in habitat	Value index	
	nr.	%	%	F**	M***
1	2	3	4	5	6
VEGETATION COVER	x	81,0	x	x	x
TOTAL HOLLOW	x	19,0	x	x	x
From wich: soil	x	14,1	x	x	x
stones	x	4,9	x	x	x
Poaceae (P %)			**61,1**		
Festuca valesiaca	142	93,4	25,19	5	3
Bothriochloa ischaemum	133	87,5	20,26	3	0
Stipa capillata	48	31,6	2,98	3	0
Cynodon dactylon	41	27,0	2,62	6	2
Chrysopogon gryllus	31	20,4	3,75	4	7
Poa bulbosa	31	20,4	0,90	6	1
Melica ciliata subsp. *ciliata*	16	10,5	0,03	4	2
Bromus tectorum	15	9,9	0,39	5	2
Dactylis glomerata subsp. *glomerata*	15	9,9	0,03	9	8
Poa angustifolia	15	9,9	0,57	7	5
Elymus repens	14	9,2	1,19	3	0
Koeleria splendens	12	7,9	019	5	3
Agropyron cristatum subsp. *pectinatum*	11	7,2	0,38	7	5
Setaria pumila	9	5,9	0,02	4	1
Bromus squarrosus	8	5,3	0,02	3	0
Bromus riparius	8	5,3	0,03	3	0
Agrostis stolonifera subsp. *stolonifera*	7	4,6	0,02	7	6
*Festuca callieri**	7	0,5	0,89	5	2
Taeniatherum caput-medusae	7	4,6	0,69	3	0
Bromus hordeaceus	6	3,9	0,11	5	5
Bromus inermis	6	3,9	0,01	8	8
Calamagrostis epigeios	6	3,0	0,01	3	0
Brachypodium sylvaticum	4	2,6	0,01	5	7
Hordeum murinum subsp. *murinum*	4	2,6	0,05	5	3
Elymus hispidus subsp. *hispidus*	4	2,6	0,01	3	0
Lolium perenne	4	2,6	0,01	9	8
Piptatherum virescens	4	2,6	0,01	3	0
Phleum phleoides	4	2,6	0,01	6	4
Phleum pratense	4	2,6	0,01	9	8

1	2	3	4	5	6
Stipa ucrainica	4	2,6	0,28	3	0
Apera spica-venti subsp. *spica-venti*	3	2,0	0,01	5	6
Sorghum halepense	3	2,0	0,01	3	0
Tragus racemosus	3	2,0	0,01	3	0
Digitaria ischaemum	2	1,3	0,01	3	0
Agropyron ponticum	1	0,7	0,01	3	0
Aegilops cylindrica	1	0,7	0,01	5	3
Alopecurus pratensis	1	0,7	0,01	8	7
Brachypodium pinnatum	1	0,7	0,01	5	7
Cleistogenes serotina	1	0,7	0,01	3	0
Festuca pratensis	1	0,7	0,01	9	8
*Koeleria lobata**	1	0,7	0,23	5	3
Setaria viridis	1	0,7	0,01	4	4
Stipa tirsa	1	0,7	0,08	3	0
Fabaceae (P%)			**0,7**		
Medicago falcata	24	15,8	0,15	7	6
Lotus corniculatus	16	10,5	0,10	8	6
Trifolium arvense	10	6,6	0,04	4	2
Coronilla varia	9	5,9	0,03	1	0
Astragalus onobrychis	7	4,6	0,11	5	4
Medicago lupulina	5	3,3	0,02	8	3
Onobrychis viciifolia	5	3,3	0,04	8	8
Trifolium campestre	5	3,3	0,04	7	2
Lathyrus tuberosus	5	3,3	0,01	3	0
*Astragalus glaucus**	3	2,0	0,07	5	4
Lathyrus pratensis	2	1,3	0,01	7	6
Medicago minima	2	1,3	0,02	7	1
Astragalus glycyphyllos	1	0,7	0,01	5	6
Astragalus cicer	1	0,7	0,01	5	4
Coronilla scorpioides	1	0,7	0,01	1	0
Lathyrus sphaericus	1	0,7	0,01	6	1
Melilotus officinalis	1	0,7	0,01	6	7
Trifolium alpestre	1	0,7	0,01	6	3
Trifolium diffusum	1	0,7	0,01	3	0
Trifolium scabrum	1	0,7	0,01	6	4
Vicia cracca	1	0,7	0,01	7	6
Vicia villosa	1	0,7	0,01	6	6
Other families (P%)			**19,2**		
Achillea coarctata	31	20,4	0,35	6	3
Achillea collina	3	2,0	0,01	6	5
Achillea leptophylla	6	3,9	0,01	3	0
Achillea nobilis subsp. *neilreichii*	6	3,9	0,01	3	0
Achillea pannonica	27	17,8	0,57	6	5
Achillea setacea	11	7,2	0,08	6	3
Acinos arvensis subsp. *arvensis*	6	3,9	0,01	3	0
Adonis vernalis	14	9,2	0,14	1	0

1	2	3	4	5	6
Agrimonia eupatoria subsp. *eupatoria*	26	17,1	0,08	3	0
Ailanthus altissima	5	3,3	0,04	3	0
Ajuga chamaepytis subsp. *chamaepytis*	8	5,3	0,05	3	0
Ajuga laxmannii	5	3,3	0,01	4	2
Allium flavum subsp. *flavum*	13	8,6	0,02	2	0
Allium rotundum subsp. *rotundum*	11	7,2	0,02	2	0
Allium paniculatum	3	2,0	0,01	2	0
Althaea cannabina subsp. *cannabina*	3	2,0	0,01	3	0
Alyssum alyssoides	8	5,3	0,03	3	0
Alyssum hirsutum	5	3,3	0,01	3	0
Amaranthus albus	4	2,6	0,01	3	0
Anthemis ruthenica	10	6,6	0,02	3	0
Anthemis tinctoria subsp. *tinctoria*	3	2,0	0,01	3	0
Arabis turrita	3	2,0	0,01	3	0
Artemisia austriaca	87	57,2	3,30	2	0
Artemisia absinthium	4	2,6	0,01	2	0
Asparagus tenuifolius	4	2,6	0,01	3	0
*Asparagus verticillatus**	6	3,9	0,01	3	0
Asperula cynanchica	19	12,5	0,13	3	0
Asperula tenella	17	11,2	0,03	3	0
Atriplex littoralis	3	2,0	0,01	3	0
Ballota nigra subsp. *nigra*	7	4,6	0,01	3	0
Berteroa incana	11	7,2	0,04	3	0
Lithospermum purpurocaeruleum	3	2,0	0,01	3	0
Bupleurum falcatum subsp. *falcatum*	3	2,0	0,01	3	0
Carduus acanthoides	9	5,9	0,02	2	0
Carduus nutans	8	5,3	0,03	2	0
Carduus thoermeri	19	12,5	0,04	2	0
Carex humilis	3	2,0	0,03	4	1
Carlina biebersteinii subsp. *brevibracteata*	4	2,6	0,01	3	0
Carthamus lanatus	7	4,6	0,02	3	0
Carpinus orientalis juv.	4	2,6	0,04	3	0
Centaurea biebersteinii	10	6,8	0,01	3	0
Centaurea diffusa	32	21,1	0,15	4	4
Centaurea rutifolia subsp. *jurineifolia*	5	9,3	0,01	3	0
Centaurea solstitialis	4	2,6	0,01	2	0
*Centaurea gracilenta**	11	7,2	0,02	3	0
Cephalaria transylvanica	6	3,9	0,01	3	0
Chenopodium album	3	2,0	0,01	3	0
Chondrilla juncea	66	43,4	0,30	3	0
Cichorium intybus	36	23,7	0,15	5	6
Cirsium arvense	3	2,0	0,01	3	0
Cirsium vulgare	4	2,6	0,01	3	0
Consolida regalis subsp. *regalis*	10	6,8	0,03	3	0

1	2	3	4	5	6
Convolvulus arvensis	19	12,5	0,07	7	6
Convolvulus cantabricus	14	9,2	0,32	3	0
Convolvulus lineatus	3	3,3	0,01	3	0
Cotinus coggygria juv.	5	3,3	0,01	3	0
Crataegus monogyna subsp. *monogyna* juv.	42	27,6	0,89	3	0
Crepis foetida subsp. *rhoeadifolia*	8	5,3	0,02	3	0
Cruciata pedemontana	5	3,3	0,09	3	0
Daucus carota subsp. *carota*	18	11,8	0,10	6	5
*Dianthus nardiformis**	20	13,2	0,43	3	0
Dianthus giganteus subsp. *giganteus*	7	4,6	0,01	3	0
Digitalis lanata	10	6,6	0,02	3	0
Echinops ritro subsp. *ruthenicus**	8	5,3	0,04	3	0
Echium italicum	7	4,6	0,02	3	0
Echium vulgare	11	7,2	0,03	4	3
Elaeagnus angustifolia	3	2,0	0,01	3	0
Erodium cicutarium	11	7,2	0,05	3	0
Erigeron annuus subsp. *annuus*	3	2,0	0,01	3	0
Conyza canadensis	3	2,0	0,01	3	0
Eryngium campestre	101	66,4	0,84	3	0
Erysimum diffusum	6	3,9	0,01	3	0
Erysimum cuspidatum	6	3,9	0,01	3	0
Euphorbia agraria	3	2,0	0,01	1	0
Euphorbia glareosa subsp. *dobrogensis*	3	2,0	0,01	1	0
Euphorbia glareosa subsp. *glareosa*	3	2,0	0,08	1	0
Euphorbia seguieriana	22	14,5	0,97	1	0
Euphorbia virgata subsp. *virgata*	3	2,0	0,01	1	0
Filipendula vulgaris	8	5,3	0,01	5	4
Fragaria viridis subsp. *viridis*	21	13,8	0,18	4	1
Fraxinus ornus juv.	4	2,6	0,01	3	0
Galium humifusum	39	25,7	0,20	5	2
Galium octonarium	5	3,3	0,01	3	0
Galium verum	19	12,5	0,05	5	4
Geranium sanguineum	4	2,6	0,01	3	0
Haplophyllum suaveolens	3	2,0	0,02	3	0
Heliotropium europaeum	3	2,0	0,01	3	0
Herniaria glabra	16	10,5	0,15	3	0
Hieracium bauhinii	9	5,9	0,03	3	0
Hieracium pilosella	6	3,9	0,05	4	1
Hypericum elegans	11	7,2	0,02	3	0
Hypericum perforatum	8	5,3	0,02	1	0
Inula hirta	7	4,6	0,01	3	0
Inula oculus-christi	10	606	0,12	3	0
Juncus inflexus	4	2,6	0,01	3	0
Linaria genistifolia	14	9,2	0,02	3	0

1	2	3	4	5	6
Linaria vulgaris	5	3,3	0,01	3	0
Linum austriacum	3	2,0	0,01	3	0
Lychnis coronaria	5	3,3	0,01	3	0
Marrubium peregrinum	27	17,8	0,35	3	0
Nigella arvensis	4	2,6	0,01	3	0
Odontites serotina	4	2,6	0,01	3	0
Onosma visianii	3	2,0	0,01	3	0
Origanum vulgare	7	4,6	0,01	4	4
Orlaya grandiflora	6	3,9	0,01	3	0
*Paeonia peregrina**	9	5,9	0,01	3	0
Phlomis tuberosa	3	2,0	0,01	3	0
Pimpinella tragium subsp. *lithophila**	4	2,6	0,06	3	0
Plantago argentea	5	3,3	0,03	5	2
Plantago lanceolata	35	23,0	0,41	6	1
Portulaca oleracea	3	2,0	0,01	3	0
Potentilla argentea subsp. *argentea*	49	32,2	0,47	4	2
Potentilla pedata	10	6,6	0,04	4	2
Potentilla recta subsp. *recta*	7	4,6	0,08	3	0
Prunus cerasifera juv.	3	2,0	0,01	3	0
Prunus spinosa subsp. spinosa juv.	4	2,6	0,01	3	0
Prunella vulgaris	3	2,0	0,01	4	2
Pyrus pyraster juv.	8	5,3	0,02	3	0
Reseda lutea	7	4,6	0,03	3	0
Rosa canina sensu lato	9	5,9	0,02	3	0
Rosa gallica	5	3,3	0,01	3	0
Rosa pimpinellifolia	7	4,6	0,01	3	0
Rubus caesius	5	3,3	0,05	3	0
Rumex acetosa	4	2,6	0,01	4	5
Salvia nemorosa subsp. *nemorosa*	5	3,3	0,01	3	0
Salvia nutans	4	2,6	0,03	4	2
Salvia verticilata	5	3,3	0,01	3	0
Sambucus ebulus	7	4,6	0,01	3	0
Sanguisorba minor	40	26,3	0,33	3	0
Scabiosa ochroleuca	6	3,9	0,03	4	4
Scabiosa argentea	5	3,3	0,01	3	0
Scleranthus annuus subsp. *annuus*	8	5,3	0,02	3	0
Scleranthus perennis subsp. *perennis*	7	4,6	0,04	3	0
Sedum urvillei subsp. *hillebrandtii*	18	11,8	0,34	3	0
Seseli tortuosum	5	3,3	0,01	3	0
*Stachys angustifolia**	6	3,9	0,04	3	0
Stachys recta	9	5,9	0,02	3	0
Stachys germanica	6	3,9	0,01	3	0
*Tanacetum millefolium**	3	2,0	0,01	3	0
Taraxacum serotinum	27	17,8	0,10	5	2
Teucrium chamaedrys	58	38,2	0,88	3	0
Teucrium polium subsp. *capitatum*	71	46,7	0,62	3	0

1	2	3	4	5	6
Thalictrum minus subsp. *minus*	6	3,9	0,01	3	0
Thymus pannonicus subsp. *pannonicus*	80	52,6	1,94	4	2
*Thymus zygioides**	26	17,1	0,67	4	1
Torilis arvensis subsp. *arvensis*	6	3,9	0,01	3	0
Urtica dioica subsp. *dioica*	6	3,3	0,01	5	7
Verbascum banaticum	21	13,8	0,04	3	0
Verbascum phlomoides	12	7,9	0,04	1	0
Verbascum speciosum	10	6,6	0,02	3	0
Verbascum thapsus	3	2,0	0,01	3	0
Veronica austriaca subsp. *austriaca*	3	2,0	0,01	3	0
Vinca herbacea	5	3,3	0,01	3	0
Vincetoxicum hirundinaria subsp. *hirundinaria*	8	5,3	0,02	3	0
Xanthium spinosum	14	9,2	0,03	3	0
Xanthium strumarium	4	2,6	0,01	2	0
Xeranthemum annuum	26	17,1	0,10	3	0

Species present in two plots, (1,3% presence, 0,01% participation on average, generally with indexes 1 – toxic plants, 2 – plants that depreciates the quality of the products, 3 – harmful to herbaceous layer, all of them without foraging value): *Adonis flammea, Ajuga salicifolia*, *Allium saxatille*, Alyssum desertorum, Amaranthus retroflexus*, *Anagallis arvensis*, *Anchusa azurea*, *Anthericum ramosum*, *Aster linosyris*, *Calamintha einseleana*, *Campanula romanica**, *Centaurea scabiosa* subsp. *scabiosa, Chenopodium schraderianum, Clematis vitalba*, *Clinopodium vulgare*, *Cornus mas* juv., *Cynanchum acutum, Delphinium fissum, Diplotaxis muralis, Euphorbia cyparissias, Falcaria sioides, Galium dasypodum, Galium rubioides, Gypsophila glomerata, Gleditsia triacanthos* juv*., Helichrysum arenarium* subsp. *arenarium*, *Herniaria hirsuta, Inula germanica, Iris suaveolens, Marrubium vulgare, Matricaria chamomilla, Onopordum acanthium, Polygonum aviculare, Quercus pubescens* juv., *Salvia aethiopis*, Sanguisorba officinalis, Sambucus nigra, Satureja coerulea*, Sempervivum ruthenicum*, Sideritis montana* subsp. *montana, Silene compacta*, Sinapis arvensis, Stachys annua, Tanacetum corymbosum, Tragopogon dubius, Tribulus terrestris. Valerianella locusta, Veronica spicata, Viola tricolor.*

Species in just one plot (0,7% presence, "+" participation, in general with index 1 – toxic plants, 2 – plants that depreciates the quality of the products, 3 – harmful to herbaceous layer, all of them without foraging value): *Achillea clypeolata**, *Allium flavescens*, *Allium fuscum* subsp. *fuscum*, *Allium flavum* subsp. *tauricum**, *Allium guttatum**, *Alyssum caliacrae*, *Alyssum strigosum*, *Alyssum saxatile, Althaea pallida, Anthemis arvensis, Anthriscus sylvestris, Aristolochia clematitis*, *Artemisia annua*, *Artemisia pontica*, *Aster oleifolius*, *Campanula bononiensis*, *Carex halleriana*, *Centaurea gracilenta*, *Centaurea orientalis*, *Centaurium erythraea* subsp. *erythraea*, *Cerastium brachypetalum*, *Crepis sancta, Daucus broteri, Daucus guttatus* subsp. *zahariadii, Datura stramonium, Dianthus membranaceus, Dianthus pseudarmeria, Dianthus pallens, Echinops sphaerocephalus, Fagopyrum convolvulus, Galium flavescens, Glechoma hirsuta, Hieracium echioides, Inula britannica, Inula ensifolia, Iris variegata, Jurinea dobrogensis, Lappula squarrosa, Lactuca serriola, Lathyrus collinus, Lavatera thuringiaca, Leontodon asper, Leontodon hispidus, Ligustrum vulgare, Lycopsis arvensis, Mercurialis perennis, Morus alba* juv*., Morus nigra* juv*., Muscari tenuiflorum,*

Nectaroscordum siculum subsp. *bulgaricum*, Onopordum tauricum, Orchis morio, Paliurus spina-christi*, Hieracium pilosella*, *Polygonatum odoratum, Potentilla heptaphylla, Prunus tenella, Pyrus elaeagrifolia* juv.*, Rapistum perenne, Rorippa sylvestris, Rubus canescens, Salsola kali* subsp. *ruthenica, Scrophularia nodosa, Scorzonera austriaca, Sedum maximum, Senecio vernalis, Seseli annuum, Seseli pallasii, Silene alba* subsp. *latifolia, Silene dichotoma* subsp. *dichotoma*, *Silene otites* subsp. *otites, Sorbus torminalis, Tilia tomentosa* juv., *Tordylium maximum, Ulmus minor* juv.*, Verbena officinalis, Veronica paniculata, Viola hirta, Viola jordani.*	
Pastoral value (PV)	23,50
Quality index	Poor
Useful green mass average index (M)	1,36
Useful green mass (GM t/ ha)	2,72
Optimum stocking rate for 185 days grazing period (LU/ha)	0,23

*) - rare, protected species
F** - foraging value index
M*** - useful green mass index

The Poaceae Family includes 44 species, Fabaceae Family 23 species and other families 283 species. We identified 24 protected plant species plants, marked with an asterisk in the synthetic habitat survey.

Due to overgrazing and other causes according to the present legislation (*** 2019), eight species of native expansive plants are mentioned in the PND: *Botriochloa ischaemum, Calamagrostis epigeios, Asperula cynanchica, Carduus nutans, Cirsium vulgare, Crataegus monogyna, Eryngium campestre* and *Prunus spinosa*.

There are also nine species of adventitious and invasive plants for the flora of Romania (SÎRBU, OPREA, 2011): *Ailanthus altissima, Amaranthus retroflexus, Eleagnus angustifolia, Datura stramonium, Morus alba, Morus nigra, Prunus cerasifera, Sorghum halepense* and *Xanthium spinosum.*

Another important aspect from an economic point of view, the steppe grasslands of the PND of the year 2019 does not differ much in composition from those of Babadag and Casimcei plateaux described 40 years ago. Thus, the pastoral value (PV) of 23.5 is considered poor, as well as the useful grass production (GM) of only 2.72 t/ ha and the optimum stocking rate of only 0.23 LU/ ha.

The results allowed us to make a comparison between the current state of productivity and what was happening about 45-50 years ago (Table 5).

Table 5. Comparative synthesis of the productivity dynamics of steppe grasslands from the Podișul Nord-Dobrogean site

Tabel 5. Sinteza comparativă a dinamicii productivității pajiștilor stepice din situl Podișul Nord Dobrogean

Plateau	Pastoral value (PV)	Forage production (GM t/ha)	Optimal loading (LU/ha)
Babadag (1970)	31,9	4,47	0,37
Casimcea (1975)	19,2	2,62	0,22
Difference B - C; +, -	+ 12,7	+ 1,85	+ 0,15
% B - C	166	170	170
Average B + C	**25,6**	**3,55**	**0,30**
Average NDP(2019)	**23,5**	**2,72**	**0,23**
Difference NDP - BC; +, -	- 2,1	- 0,83	- 0,07
% NDP - BC	**92**	**77**	**77**
Rate of degradation in 45-50 years (%/ year)	0,15	0,5	0,5

From this comparison, we notice a rate of decrease of the pastoral value by 0.15% per year and of the production and the optimum-stocking rate by 0.5% per year from the first productivity assessments.

To establish the stocking rate per hectare, we have registered the number of livestock and grassland surfaces from 2018, data made available by CAD Tulcea (Table 6).

Table 6. The number of livestock expressed in livestock units (LU) and the stocking rate of grasslands in the Podișul Nord-Dobrogean site in 2018

Tabel 6. Efectivele de animale exprimate în unități vită mare (UVM) și încărcarea cu animale a pajiștilor din situl Podișul Nord-Dobrogean în 2018

Nr. crt.	Locality (TAU)	Cows	Sheep	Goats	Horses	TOTAL (LU)	Grasslands (ha)	UVM/ha	
								Real	Projected
1	Babadag	235	58	73	-	366	465	0,79	0,29
2	Baia	392	2.006	680	62	3.140	2.168	1,45	0,56
3	Beidaud	821	463	536	-	1.820	2.408	0,76	0,32
4	Casimcea	985	2.884	392	199	4.460	3.744	1,19	0,56
5	Ceamurlia de Jos	215	598	260	-	1073	580	1,85	0,41
6	Cerna	35	3.620	665	-	4.320	3.149	1,37	0,64
7	Ciucurova	31	368	154	38	591	565	1,05	0,32
8	Dorobanțu	68	1.288	868	-	2.224	2.624	0,85	0,22
9	Dăeni	195	647	115	108	1.060	1.152	0,92	0,34
10	Horia	33	280	189	-	502	1.124	0,45	0,22

Nr. crt.	Locality (TAU)	Cows	Sheep	Goats	Horses	TOTAL (LU)	Grasslands (ha)	UVM/ha	
								Real	Projected
11	Izvoarele	113	568	326	-	1.007	1.099	0,92	0,16
12	Jurilovca	134	592	253	-	979	2.101	0,47	0,39
13	Mihai Bravu	267	572	393	-	1.232	1.105	1,11	0,43
14	Nalbant	63	317	138	-	518	1.321	0,39	0,37
15	Ostrov	134	706	34	-	874	590	1,48	0,29
16	Peceneaga	45	647	168	148	1.008	338	2,98	0,25
17	Sarichioi	52	114	21	-	187	504	0,37	0,34
18	Slava Cercheză	34	350	70	7	461	441	1,05	0,23
19	Stejaru	387	1.148	343	20	1898	663	2,86	0,23
20	Topolog	812	1.371	904	476	3.563	3.295	1,08	0,29
T O T A L		**5.051**	**18.597**	**6.582**	**1.053**	**31.283**	**29.430**	**1,06**	**0,34**

From this data it turns out that in the 20 localities in our area of study, there is a total of over 31.3 thousand LU, out of which more than 90% are sheep and goats that graze all year round, except for the winter days with a snow layer. The livestock grazes on 29.4 thousand hectares of permanent grassland.

To complete the datasets, we analysed the pastoral arrangements made between 2005 and 2019 for all 20 localities. We found data on the projected optimal stocking rate, in accordance with the current productivity of the grasslands.

The analysis of the pastoral arrangements shows that the stocking rate on pastures is above the productive potential of the grasslands in all TAUs (Territorial Administrative Units) when compared to the one evaluated on scientific basis in 2019, respectively from 1.5-2 times in the Sarichioi, Nalbant and Horia villages, up to 12-13 times the carrying capacity in Peceneaga and Stejaru villages.

The average value for the 20 TAUs is 1.06 LU/ ha, exceeding 4.6 times the optimal load (0.23 LU/ ha) evaluated using the floristic surveys and even 3.1 times the projected one (0.34 LU/ ha) in the pastoral arrangements already approved by the village councils.

Surprisingly, the designers of the pastoral arrangements for the most crowded pastures with animals from the Podișul Nord-Dobrogean, respectively the Peceneaga and Stejaru villages, set an optimum of 0.23-0.25 LU/ ha, exactly as our assessments.

Preliminary conclusions

The vegetation of the steppe grasslands from the Podișul Nord-Dobrogean site are in a very advanced state of vegetative and productive degradation due to overgrazing, especially by sheep and goats, this issue being the main factor of degradation of the biodiversity, environment and pastoral economy.

Interdisciplinary research and studies that evaluate the vegetation diversity and productivity of the permanent grasslands, with the assessment based on floristic surveys and determination of the optimum carrying capacity and stocking rates, are an essential scientific support for the elaboration of the management plans for the protected areas.

Establishing the optimal stocking rate and grazing period on the existing grasslands for each of the 20 TAUs in the Podișul Nord-Dobrogean site, as well as the production of forages on arable land, are the main prospective actions to reduce the current anthropogenic pressure in order to preserve biodiversity, environment and landscapes.

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Teodor MARUȘCA[1], Adrian OPREA[2], Daniyar MEMEDEMIN[1], Oliviu Grigore POP[1], Marcel ȚÎBÎRNAC[1], Daniel Ioan MAFTEI[1], Ioana SIMION[1], Elena TAULESCU[3]

[1] *Association for Sustainable Development DAKIA Bucharest*
maruscat@yahoo.com

[2] *Progresul Silvic Society, Bucharest*

[3] *Research and Development Institute for Grasslands, Brașov*